

NUTRIENT CYCLES IN ECOSYSTEMS

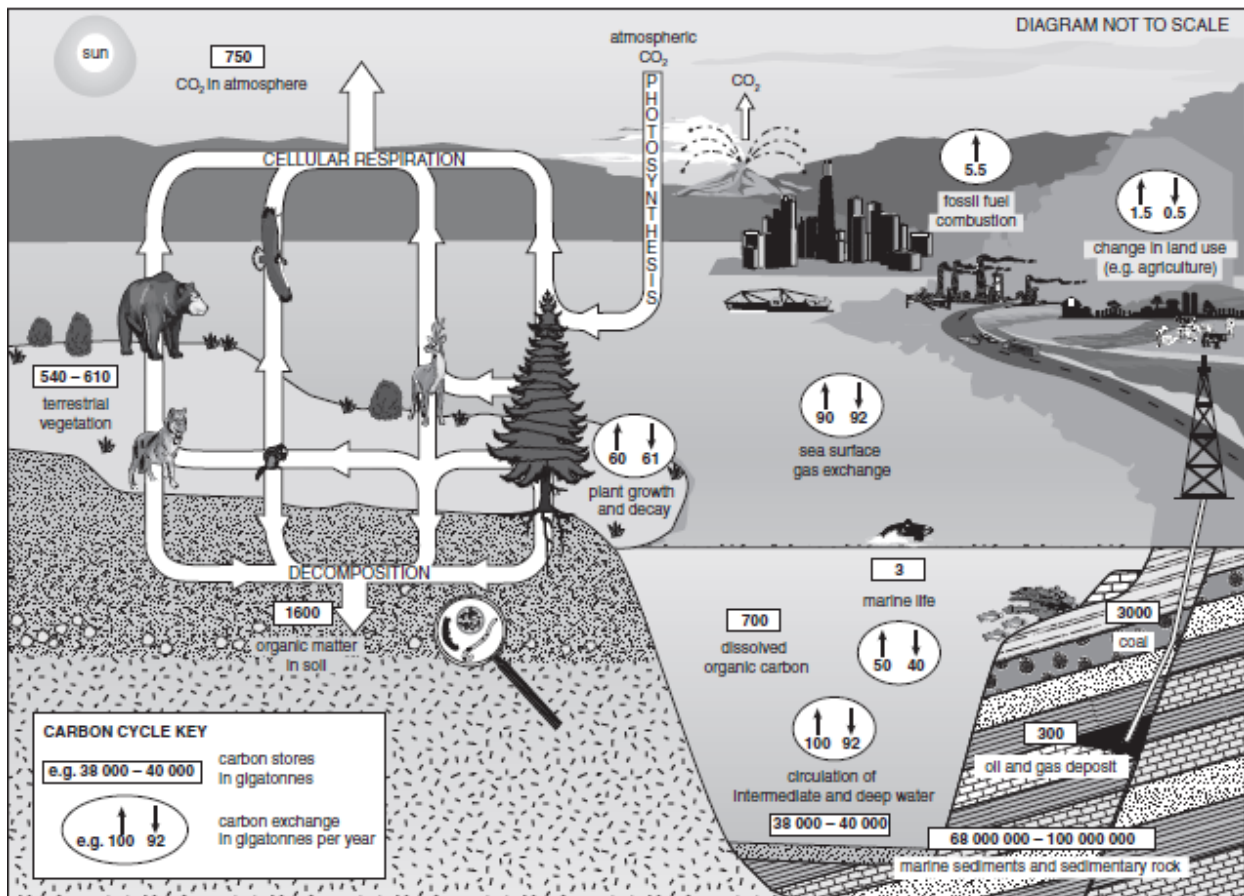
NUTRIENTS are chemicals required for plant and animal growth and other life processes. They are constantly recycled within Earth's biosphere. Nutrients spend different amounts of time in stores within the atmosphere, oceans, and land.

Nutrients are stored for short periods of time in short-term stores, such as living organisms and the atmosphere. Nutrients can also be incorporated into longer-term stores, such as the Earth's crust.

NUTRIENT CYCLES describe the flow of nutrients in and out of stores as a result of biotic and abiotic processes. Without human interference, nutrient cycles are almost perfectly balanced. There are three main cycles that move nutrients through terrestrial and aquatic ecosystems.

- **CARBON CYCLE**
- **NITROGEN CYCLE**
- **PHOSPHORUS CYCLE**

THE CARBON CYCLE

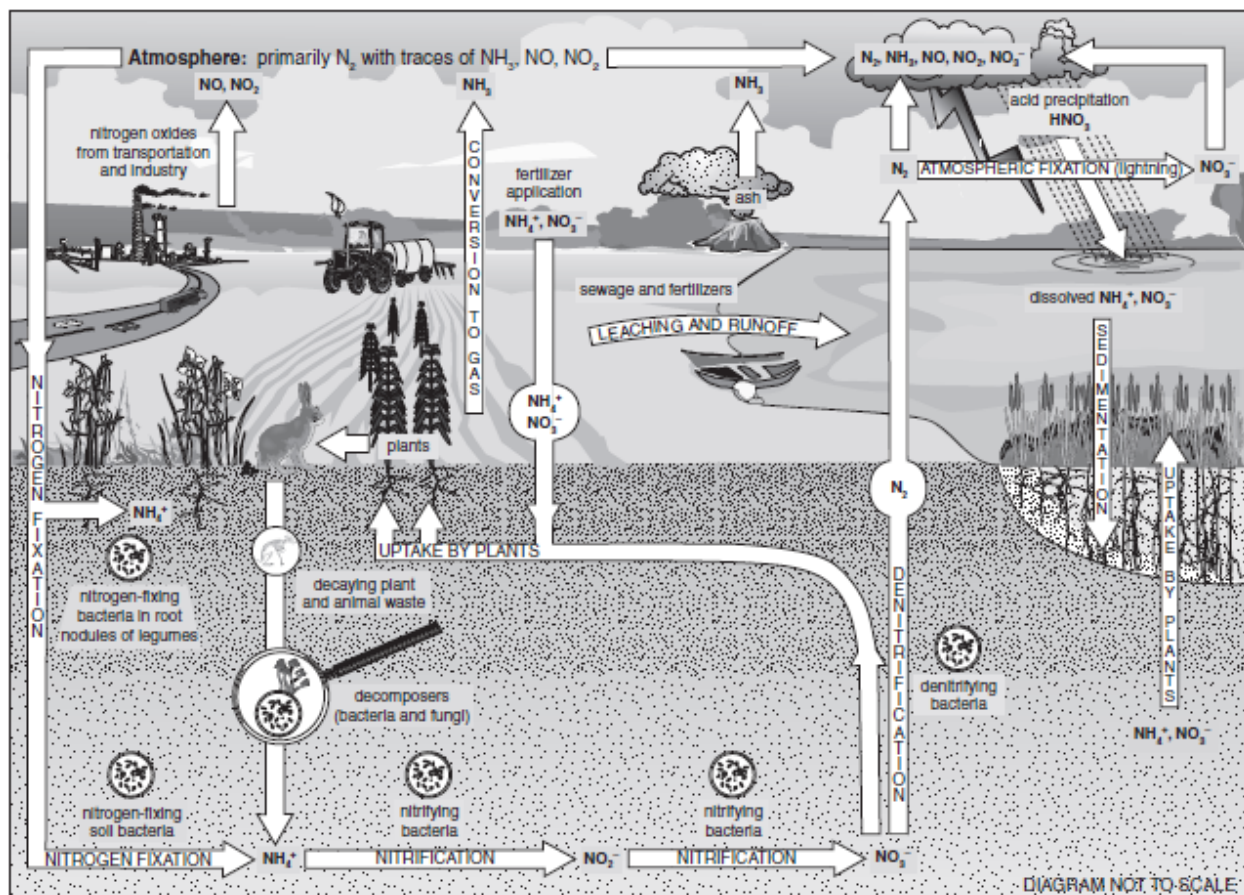


Carbon is an essential component of cells and life-sustaining chemical reactions. Carbon is cycled through living and decaying organisms, the atmosphere, bodies of water, and soil and rock. Carbon moves between stores via six main processes:

1. **Photosynthesis:** Photosynthesis is a chemical reaction that converts solar energy and atmospheric carbon dioxide gas (CO_2) into chemical energy.
2. **Cellular Respiration:** During cellular respiration, plants and animals obtain energy by converting carbohydrates and oxygen (O_2) into carbon dioxide and water.
3. **Decomposition:** Decomposers release carbon dioxide into the atmosphere through the decomposition of carbon-rich organic matter in soil.
4. **Ocean Processes:** Dissolved carbon dioxide is stored in oceans. Marine organisms store carbon-rich carbonate (CO_3^{2-}) in their shells, which eventually form sedimentary rock.
5. **Volcanic Eruptions.** Occasionally some carbon dioxide is released from volcanoes following the subduction and melting of sedimentary rock in tectonic plates.
6. **Forest Fires.** Some carbon dioxide is rapidly released during forest fires.

Human activities, such as fossil fuel combustion and land clearance, quickly introduce carbon into the atmosphere from longer-term stores. These actions increase the levels of carbon dioxide, a greenhouse gas that contribute to global climate change.

THE NITROGEN CYCLE



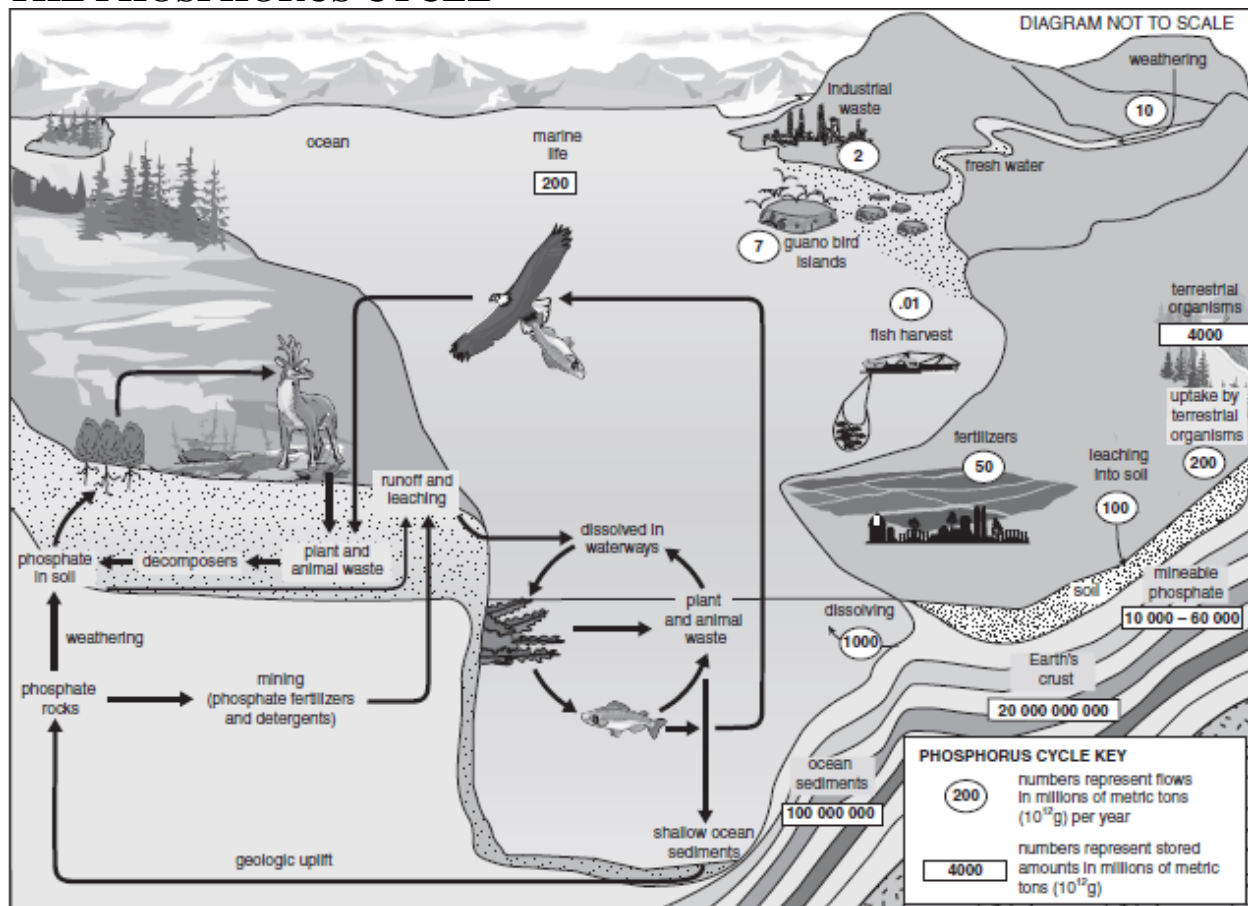
Nitrogen is an important component of DNA and proteins. Most nitrogen is stored in the atmosphere, where it exists as nitrogen gas (N_2). It is also stored in bodies of water, living organisms, and decaying organic matter. Most organisms cannot use atmospheric nitrogen gas. The nitrogen cycle involves four processes, three of which make nitrogen available to plants and animals:

1. **Nitrogen Fixation:** Nitrogen gas is converted into nitrate (NO_3^-) and ammonium (NH_4^+), compounds that are usable by plants. Nitrogen fixation occurs mainly through nitrogen-fixing bacteria, and when lightning strikes in the atmosphere.
2. **Nitrification:** Ammonium is converted into nitrate and nitrite (NO_2^-) through the work of nitrifying bacteria.
3. **Uptake:** Useable forms of nitrogen are taken up by plant roots and incorporated into plant proteins. When herbivores and omnivores eat plants, they incorporate nitrogen into their own tissues.

4. **Denitrification:** Denitrifying bacteria convert nitrate back into atmospheric nitrogen.

Fossil fuel combustion and burning organic matter release nitrogen into the atmosphere, where it forms acid rain. Chemical fertilizers also contain nitrogen, which escapes into the atmosphere or leaches into lakes and streams. High levels of nitrogen cause eutrophication (too many nutrients) and increased algal growth in aquatic ecosystems, depriving aquatic organisms of sunlight and oxygen.

THE PHOSPHORUS CYCLE



Phosphorus carries energy to cells. It is found in phosphate (PO_4^{3-}) rock and sediments on the ocean floor. Weathering – through chemical or physical means – breaks down rock, releasing phosphate into the soil from longer-term stores. Organisms take up phosphorus. When they die, decomposers return phosphorus to the soil. Excess phosphorus settles on floors of lakes and oceans, eventually forming sedimentary rock. It remains trapped for millions of years until it is exposed through geologic uplift or mountain building.

Commercial fertilizers and phosphate-containing detergents enter waterways and contribute additional phosphate to the phosphorus cycle. Slash-and-burn forest clearance reduces phosphate levels, as phosphate in trees enters soil as ash. It leaches out of the soil and settles on lake and ocean bottoms, unavailable to organisms.